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ABSTRACT

This volume is one of four sets of materials produced for training science supervisors in educational technology. Participants design an inservice institute useful to their future work, analyze and revise a hypothetical plan for an inservice institute, and review and revise their own plans. Guidelines for institutes are provided. Supervisors are expected to be able to use the materials of the previous two sets (bibliography appended). The outline of the curriculum for a scientific literacy program upon which the hypothetical institute is based, contains descriptions of the school district concerned, definitions of scientific literacy, philosophy of the curriculum behavioral objectives of the course, a content outline and procedures for evaluating pupils. The plan of the institute to be criticized contains statements of its philosophy, behavioral objectives, structure, and evaluation. Pre-institute activities and a flow chart are included. (AL)

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# EDUCATIONAL TECHNOLOGY PROJECT

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## AN APPLICATION OF EDUCATIONAL TECHNOLOGY

## SET III

## VOLUME FOUR

SE 009 862

NATIONAL SCIENCE TEACHERS ASSOCIATION
1201 Sixteenth St., N.W., Washington, D.C. 20036

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education Bureau of Research

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# F I N A L  R E P O R T

PROJECT NO. 8-0427

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## V O L U M E  F O U R

## AN APPLICATION OF EDUCATIONAL TECHNOLOGY (SET III)

Educational Technology Project
National Science Teachers Association
Washington, D.C. 20036

February 1970

U.S. DEPARTMENT OF
HEALTH, EDUCATION, & WELFARE
OFFICE OF EDUCATION
BUREAU OF RESEARCH

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Set III is a simulation activity involving the supervisor in preparation and evaluation of inservice programs. The material was developed by

Albert F. Eiss

Editing by

Clarice Leslie

George H. Ziener

Manuscript Coordinator: Dorothy B. Lutz

overview

# I BEHAVIORAL GOALS FOR SET III (APPLICATIONS)

1. The participant will develop a working outline utilizing a learning system approach for an inservice institute for science teachers. The outline will include:

    a. Pertinent information about the institute participants necessary in designing the program.
    b. A statement of the general philosophy of the institute.
    c. Statements of at least three general behavioral goals for the institute participants.
    d. At least one example of a behavioral objective and a corresponding criterion assessment item to be used in the institute.
    e. A general statement of the content of the institute.
    f. A list of the possible learning techniques employed with justifications for at least two different techniques.
    g. A management plan for the operation of the institute.
    h. Plans for evaluating the institute.

2. The participant will examine the curriculum plan on "Develop Scientific Literacy" (Part Two-A, pages 9-34) and will

a. evaluate the effectiveness of the program to achieve its stated goals;

b. recommend specific ways for improving the program with emphasis on learning strategies;

c. develop at least two criterion (one cognitive and one affective) assessments for determining attainment of any two of the objectives stated.



3. The participant will examine the learning system model and description of an inservice institute (Part Two-B, pages 36-50) and

   a. evaluate the model institute plans on the basis of achieving the stated philosophy and goals;

   b. recommend and justify revisions in the model institute structure.

4. The participant will compare the program he prepared in Item I with the simulated model, recommend changes in the plans for his program, and justify his recommendations.

5. The participant will search for further information on scientific literacy and will discuss with others the need for introducing programs of this type into the curriculum.

# INTRODUCTION TO PROCEDURES

The material and your activities in this Set center around the application of educational technology to the development of an inservice teachers institute. Learning activity is at your option: You can work with a small group (from two to six or eight) or work alone. The only guiding restriction is that in designing your own inservice program, the result should be a useful product to you. It would be best then, if this activity were carried out alone or with others who have the same inservice needs and type of participants. Otherwise the activity will become a textbook exercise rather than the production of a useable product. Interaction with other science supervisors regarding their inservice institute models is encouraged and will prove valuable in redesigning your own institute.



There are three basic activity sections in this Set.

You will design an inservice institute for use in your work. You may choose any purpose for the institute that you wish, as long as it is one that can actually be used if and when you have the opportunity. In order to provide some uniformity in planning, a tentative outline will be provided which you may or may not choose to follow in detail.

(A and B):

After the plan is developed, you will be asked to review the plan for a hypothetical curriculum intended to develop scientific literacy. The system plans to adopt the program, and has developed an inservice institute to prepare teachers to teach it. You, as science supervisor, must analyze the curriculum and the plans for the institute, suggesting methods for improving both curriculum and institute plans.

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On the basis of your experience with the model institute and interaction with other science supervisors, review and revise your own institute plans.

In addition to the material supplied in parts one, two, and three, you may need specific in-depth learning materials in certain areas of educational technology. The Appendix lists all of the Level II material included in Set II along with some additional material. You are free to stop what you are doing at any time and utilize any of the specific items that will meet your needs. Each of the items listed in the appendix will have with it a form of pre-test to allow you to determine more specifically your own areas of learning need.

Please follow each task without "reading ahead" in the remainder of the materials. IT IS IMPORTANT THAT YOU FOLLOW EACH IN SEQUENCE. When you have finished one part you may go right on to the next.

At this point proceed to the next section.

part one

## INITIAL ACTIVITY

For this part of Set III you will prepare an outline of a plan for an inservice institute which you would like to implement on a local level. It may deal with any area you think appropriate and necessary for use in your present job. This is not a textbook exercise. After you have completed all of Set III, we assume that you will actually try to complete planning and seek to run the actual inservice institute you have developed here.

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To establish a basic uniformity of approach for later interaction with other supervisors and with the model system in part two of your activities, the following rough outline is suggested. However, since this institute is for your own use, feel free to make alterations where necessary to meet your needs.

Your plan for an inservice institute should include

a. a statement of what is to be accomplished;

b. a description of the participants including necessary admission requirements (if any), necessary information about participants, how participants are chosen, and how the necessary information is to be obtained;

c. what will be done in the institute, including content, methods, and time schedule;

d. justification for major decisions on content and methods;

e. management plan for the institute (logistics); e.g. budget, facilities, resources, staff, equipment, and supplies;

f. how you will "know" the institute was successful; / 7

g. a flow chart of activities in developing and operating the institute.

When you have completed this exercise take a short break. Part One is now complete.

When you are ready, go on to Part Two. After you have read the material in Part Two, follow the directions at the end.

# DESCRIPTION OF A SCIENTIFIC LITERACY CURRICULUM

## C O N T E N T S


9 . . . . . BACKGROUND INFORMATION

10 . . . . . NATURE OF THE LEARNER

12 . . . . . DEFINITION OF SCIENTIFIC LITERACY

15 . . . . . PHILOSOPHY OF THE CURRICULUM

18 . . . . . GENERAL AND SPECIFIC GOALS

23 . . . . . CONTENT OUTLINE

29 . . . . . CONTINUING STUDENT EVALUATION PROGRAM

31 . . . . . DEVELOPMENT OF MATERIALS & LEARNING STRATEGY

33 . . . . . VALIDATION OF MATERIALS: ACTIVITY & RESULTS

part two - a

## Background Information

Developing a scientifically literate citizenry is commonly recognized as a critical need of our time. Fulfillment of such a need might be achieved through the development of a science curriculum specifically designed for this purpose. Another approach would be to provide additions, modifications, and/or enrichment for the existing program.



The following material has been developed as a specifically designed curriculum in scientific literacy. However, it is not being presented as a complete, polished, and packaged curriculum. The material is extensive and does represent, to a significant degree, just what such a curriculum should contain. Feel free to analyze and submit revision suggestions after you have completed your work in Set III.

For the present activity, however, consider the contents as a finished product and work on that basis.

## Nature of the Learner

The students of Grand City are somewhat typical of students in other school systems. In Grand City, as at the national level, about 1.5 percent of the school-aged population become science majors and/or science teachers. About 20 percent of the population graduates from college; of the college graduates, about 23 percent become elementary and secondary teachers, not including secondary teachers in English, mathematics, science, and social studies. /10

About 28 percent of the school-aged population drop out of school before completing high school. The school dropouts are generally of the same intelligence as the students who complete high school. Many of these may be called "manually" oriented, because they are more interested in doing than in scholarship. However, some of the drop-outs are very intelligent, and appear to drop out merely because they are dissatisfied with the school curriculum and environment.

The school community is about 15 percent black, with the remainder of the population scattered among Puerto Rican, Spanish speaking, second and third generation central European, English, Scandinavian, and those with long American family histories, together with a scattering

of other minority groups. The student population shows ability and achievement scores that are typical for slightly above average city and suburban schools.

Students have been showing a growing negative attitude toward science. Enrollment in high school science courses has been dropping slightly each year, and there is some evidence of a lack of interest in elementary and junior high school science. More frequently in recent months students have been heard to express a dislike for taking science. /11

Most of the students come from upper middle class homes with parents' occupations ranging from blue collar workers to bank presidents. The students appear to be very democratic in their relationships with each other. The school system has tended to be quite restrictive in its policies, and there is some evidence of a growing unrest among students about the status quo.

The science literacy curriculum is being introduced to meet the needs of this student population. Two specific affective goals in developing the curriculum were improvement of student attitude and increasing interest in science.

## Definition of Scientific Literacy

Curriculum Title: Man and His Environment

Paul DeHart Hurd, in developing a definition of scientific literacy for the NSTA Curriculum Committee, chose to emphasize what the individual who was scientifically literate would do.

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"Goals of Science Teaching -- Science teaching should result in scientifically literate citizens.

"A statement of goals for an education in the sciences should describe what we mean by a scientifically literate person living in modern times. This person is the end product, as we see him, of ten to fifteen years of science education, beginning with kindergarten.

"What are some of the ways by which we can identify this person:

--- He has faith in the logical processes of science and uses its modes of inquiry,

--- but at the same time recognizes their limitations and the situations for which they are peculiarly appropriate.

--- He enjoys science for the intellectual stimulus it provides, for the beauty of its explanations, the pleasure that comes from knowing, and the excitement stemming from discovery.

--- He has more than a common sense understanding of the natural world.

--- He appreciates the interaction of science and technology, recognizing that each reflects as well as stimulates the course of social and economic development,

--- but he is aware that science and technology do not progress at equal rates.

--- He is in intellectual possession of some of the major concepts, laws, and theories of several sciences.

--- He understands that science is one but not the only way of viewing natural phenomena, and that even among the sciences there are rival points of view.

--- He appreciates that knowledge is generated by people with a compelling desire to understand the natural world.

--- He recognizes that knowledge in science grows, possibly without limit, and that the knowledge of one generation 'engulfs, upsets, and complements all knowledge of the natural world before.'

--- He appreciates the essential lag between frontier research and the popular understanding of new achievements and the importance of narrowing the gap.

--- He recognizes that the achievements of science and technology properly used are basic to the achievement of human welfare.

--- He recognizes that the meaning of science depends as much on its inquiry process as on its conceptual patterns and theories.

--- He understands the role of the scientific enterprise in society and

--- appreciates the cultural conditions under which it thrives.

--- He recognizes the universality of science; it has no national, cultural, or ethnic boundries.

"These goals suggest the ends of a liberal education in the sciences and there are undoubtedly other goals of importance; these statements are only suggestive."

Although many questions may be raised concerning the meaning of some of the specific items in the statement, Hurd's

summary has been accepted in principle by a large number of science teachers at both the secondary level and the college level. It may be more profitable in trying to understand the meaning of scientific literacy to study this statement in some detail, instead of trying to develop a more precise definition of the term.

## Philosophy of the Curriculum

Content: Science is becoming increasingly important in our culture. It is essential that the general public realize the influence science has on society, and have a positive attitude toward becoming scientifically literate. Analysis shows that less than one and one-half percent of school-aged children will become scientists and/or science teachers. However, everyone lives in a world effected by science. /15 There is common agreement among science educators that all individuals, including scientists and science teachers, must become scientifically literate. Also, there is general agreement among science educators that scientific literacy possesses the following components:

a. a knowledge of the major conceptual schemes of science,
b. a knowledge of the relationship between science and technology,
c. a knowledge of the impact of science and technology on society,
d. a knowledge of the processes used by scientists,
e. a knowledge of the values held by scientists.

In addition, the scientifically literate person will place a high value on scientific processes for solving problems in everyday life as well as in the laboratory. Also, he will utilize scientific processes in solving many of his

own problems.

Method: Students learn as individuals, and the instructional program should emphasize the learning process and develop an environment to encourage learning. The role of the teacher in this learning process becomes that of a mediator, rather than the sole information source. Effective learning can best be achieved by using a systematic approach to learning design and curriculum planning. In this approach, evaluation of the system and feedback of information at every step in planning, design, and implementation of the learning program are necessary. The affective domain is of primary importance in the learning process, and every opportunity must be taken to reinforce desirable attitudes and interests.

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Reinforcement of positive affective goals, will result from student involvement in planning their learning programs. Learning is not a "spectator sport." Students must be active participants in the learning process.

Reinforcement of cognitive as well as affective learning comes from three sources: internal reinforcement from the thrill of learning, the drive of unsatisfied curiosity; external reinforcement from the attitudes and encouragement of students, teachers, and peers; and psychomotor reinforcement that comes from actually "doing something." All of these avenues of reinforcement must be utilized at every opportunity.

Because science has no disciplinary constraints -- these have been imposed by teachers -- this course is intra-disciplinary in scope, and is planned as a total educational science program for the average student.

## General Goals

1. To provide the essential competencies for developing scientifically literate citizens.
2. To provide the basis for further study in science.
3. To produce a continuing interest in learning more about science and science related activities.



## Specific Behavioral Goals for the Scientific Literacy Curriculum

(Note: Preface each lettered statement, AT THE CONCLUSION OF THE LEARNING PROCESS THE STUDENT WILL:)

A. Knowledge about the nature of knowledge.

1. Explain the importance of intuition and observation in formulating an hypothesis.
2. Given statements related to scientific observations and theories, classify statements as observations, principles, assumptions, theories, or false statements.
3. Give two examples of scientific laws that do not have exceptions, and three scientific laws that do have exceptions.
4. Distinguish between an observation and an explanation.
5. Explain why scientists choose to assume that some laws do not have exceptions.

6. Describe some of the difficulties encountered in determining a cause-effect relationship between two events.
7. Explain the scientist's viewpoint of the nature of reality.
8. Draw a diagram to show the interrelationships among observations, hypotheses, inventions, and experiments.



B. Continued interest and incentive for learning.
   1. Ask intelligent questions about everyday observations that are related to science.
   2. Read and discuss scientific reports found in magazines and newspapers.
   3. Volunteer to study about some scientific topic and report his findings to the class.
   4. Question authoritative statements when conflicting evidence is discovered.
   5. Use scientific principles in solving everyday problems.

C. Use of knowledge in solving problems.
   1. Identify a simple scientific problem, suggest an hypothesis, and plan and conduct an experiment to test the hypothesis.

D. Knowledge of basic principles, concepts and theories of science.
   1. Use conceptual schemes of science to explain everyday observations of phenomena.

E. Relationship of science and technology.

1. Explain the difference between science and technology, and describe how they are interdependent on each other.
2. Describe ways in which technology has been useful in obtaining new knowledge and improving our standard of living.
3. Describe ways in which some products of technology have been harmful to society and suggest ways of remedying the problems created by the unwise use of technological devices. /20

F. How scientific knowledge grows.

1. Describe at least three examples of the way that scientific knowledge grows.
2. Show how each discovery is dependent upon the inventions and discoveries of others.

G. Limitations of science.

1. Explain why it is impossible to predict future scientific discoveries.
2. Describe the importance of values in scientific research, and tell how they are chosen.
3. Explain why it is impossible for a scientist to prove that a given theory is absolutely correct.

H. The interaction of science and society.

1. Give examples of both wise and unwise decisions con-

cerning the use of scientific discoveries, and explain why the decisions are classified as they are.

2. Name some of the kinds of pollution that are common in his local community and propose ways of lessening the dangers they create.
3. Describe some of the values and some of the dangers of a society based on science and technology, and make suggestions for lessening some of the dangers.
4. Explain the extent to which a scientist should accept the responsibility for his discoveries.
5. Explain how our knowledge of public health and medicine has affected population growth, and suggest some ways of dealing with the population problem.
6. Describe the public's responsibility for making wise use of natural resources, and tell how a group of citizens might work together to promote better use of resources.
7. Explain how improved transportation and communication have changed our social and cultural environment.
8. Describe some of the science related factors that have produced social and political conflicts, and suggest ways of dealing with these problems.
9. Take a position concerning the use of technology for national defense, including biological and chemical warfare devices, and justify the position chosen.

10. Describe the effect of population density on mental health, and describe ways in which an individual in poor mental health can be identified and obtain help.

I. The universality of science.

1. Give examples that show the international character of science.
2. Given examples of broad scientific principles, and describe ways in which these principles apply in selected situations in different branches of science. /22
3. Show how the techniques of science can be applied to other areas of learning.

## Content Outline

### General Description

The curriculum will emphasize the problem approach in which content will be introduced as it is needed, with adequate precautions that all of the content will be utilized during the program. The curriculum is designed for individualized instruction. As such each student proceeds at his own pace, individually or in small groups, and continues with the materials until the minimum goals are achieved. Students who are more interested in a subject are provided with many supplementary tasks that will permit them to work at whatever depth they are capable. /23

Initial problems are simple, and successive problems become more difficult, until the student is gradually encouraged to work at the maximum ability level of which he is capable. Some students may require the entire span of their school career to achieve the minimum goals of the program, while others may achieve them within a few years. However, the material is designed to be used throughout the student's school career, and not be concentrated in a relatively brief span of time.

The curriculum for developing scientific literacy is interdisciplinary in its organization, introducing ideas from the social studies, mathematics, composition and literature,

as well as ideas from traditional biology, physics, and chemistry as they are needed. For these reasons, it is not possible to prepare a simple curriculum outline. The outline will consist of two parts: first, examples of the types of problems that will provide the basis for the curriculum; and second, an outline of the content that will be included in the problems, with adequate provision for being sure that all aspects of the content are included somewhere as the problems are studied.



## Types of Problems

There is not enough space in this outline to describe in detail the organization of the curriculum. Instead, some examples of the types of problems are given at two levels of sophistication: introductory problems studied in the early stages of the curriculum, and more sophisticated problems for advanced students.

A. Introductory Problems.

1. What is science?

What scientists are like, what they do and how they discover new knowledge. The NSTA Science Film series provides the motivation for this problem. Also included will be programmed materials on the structure of knowledge and the processes by which new

knowledge is discovered. Each student will identify and solve a simple problem that will include developing and testing a hypothesis.

2. How do physical objects interact?

   This is a programmed sequence on Newton's Laws of Motion, requiring students to observe, predict, and experiment. Only mechanical interactions are studied in this problem. Two commercially produced films are also available.

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3. How do living things differ from nonliving things?

   This is a programmed sequence providing the students with an opportunity to study a great variety of living plants and animals, from microscopic to macroscopic. In studying the material, the student learns the basic characteristics of all living things, and begins developing concepts of adaptation and evolution.

4. How are population densities controlled?

   The student begins this sequence with a study of the ecology of a hay fusion, and moves to the study of population controls for mammals and humans. Actual projects carried out in the local area are used.

5. What is energy, and how can man utilize it?

   The student is introduced to the kinetic theory

of matter, and develops some idea of thermodynamics, including the concept of useful available energy. The study of the importance of cheap energy in developing our present culture and standards of living leads to studying the problems of thermal and atmospheric pollution in energy production. A combination of film, programmed text, and projects is used. /26

B. More Sophisticated Problems.

1. What are the effects of improved communication and transportation on international attitudes and views?
2. To what extent should a scientist accept responsibility for the use of his discoveries?
3. What are some of the limitations of scientific approach as to obtaining knowledge and information?
4. What are some possible ways of dealing with problems of chemical pollution from insecticides and fertilizers?

Scope of the Content of the Course

In addition to the post-testing for each problem, periodic criterion tests will insure that all of the following content items have been learned by the student during his study.

A. Knowledge about the nature of knowledge.

1. Relationship between process and product.

2. Science and invention.

Observations, theories, experimentation, and invention.

B. The use of knowledge in solving problems.

C. Knowledge of the basic principles, concepts and theories of science.

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1. Physical sciences: Newton's Laws of Motion, the Kinetic theory of matter and energy, thermodynamics and useful energy, the atomic theory, energy transformations, laws of statistics.

2. Biological Sciences: Characteristics of living things, the vast varieties of living forms, adaptation, evolution, human biology and reproduction, physiology, heredity, antibodies and immunization, aging, mind and thought, psychology and mental health.

3. The Conceptual Schemes of Science.

D. The relationship between science and technology.

Definitions and interaction.

E. How scientific knowledge grows.

F. Limitations of science (positive and negative).

1. Problems of predicting the future of science and technology.

2. The role of authority.

3. Non-scientific problems.

G. The interaction of science and society.

1. Favorable cultural attitudes.

2. Positive and negative values.

3. Responsibilities of scientists for human welfare.

4. Medical and public health technology.

5. The population explosion. /28

6. Environmental pollution.

7. Proper use of resources.

8. Transportation and communication.

9. War and peace.

Weapons, including nuclear, biological and chemical.

H. The universality of science.

Values and Attitudes

In addition to the topics above that are concerned with values, the course is designed to encourage continued interest and incentive for learning by challenging each student to learn and to provide him satisfaction in the process.

## Continuing Student Evaluation Program

The evaluation program is in a continuing revision process, since the entire curriculum is still being introduced into schools. The following characteristics will be retained, regardless of the extent of revision within the evaluation framework:

A. The entire curriculum will be under continuing evaluation, including the philosophy, goals and objectives, and the instructional system. Periodic learner assessment, including achievement tests, intelligence tests, aptitude tests, and preference tests, will be used to detect changes in the learner characteristics as they progress through the program.



B. Each student on entering the system will be pre-tested to determine his background knowledge and skills. This will make it possible to prescribe remedial materials whenever they are needed to bring the student up to the proper entry level.

C. Each individual learning module will have a
   1. pre-test to determine if the student already knows the material in the module and should be moved on to another item, and an
   2. entry level test to determine if the student has the necessary background skills and knowledge to begin work on the module.

D. A post-test will be administered to determine student mastery of the materials in the module. The student will be required to answer all questions correctly before he is permitted to move on to another module, but the teacher will determine standards for answer quality based upon the results of the tests in A and the teacher's knowledge of the individual learner.

E. Periodic summary tests will be given to determine the students' retention of ideas and ability to organize the material into his conceptual patterns. / 30

F. At the conclusion of the program, students will be given a final summary test to determine the extent to which they are capable of utilizing the materials learned.

All of these tests serve two vital purposes:

A. they identify where the material has not been successful with a particular student, thus enabling the teacher to guide the student to alternative learning materials that will enable the student to successfully complete a module;

B. they also identify areas where revisions must be made in the module due to continued student difficulty.

These purposes must be met if the program is to meet student needs and maintain its flexibility.

## Development of Materials & Learning Strategy

The curriculum materials were developed (or, more precisely, adapted and developed) by a working committee of twenty elementary and secondary teachers who spent three summers identifying useful materials for the curriculum, preparing learning modules, and organizing the content.

Commercial sources were used for the most part, either as available or, when necessary, adapted to meet the specific curriculum needs. Other useful sources of ideas and materials were current periodicals and industrial educational materials. Some materials were developed completely, when no useful sources could be found. All of the materials were then assembled and coordinated into an effective, working curriculum.



All development activities were based on a systems plan which provided a content outline that met the specified objectives. Each available item of material was analyzed in terms of the objectives met, the entering skills necessary for the learner, and the characteristics of the learner most suited to use the material. This information then became a permanent part of the material. In the same manner, items developed entirely by the teachers were designed to meet certain objectives and contained entry skill specifications and learner characteristic data.

Whenever possible, a number of alternate methods for

reaching specific objectives are available, especially for more difficult or involved curriculum areas. Each alternate learning module stresses different learning characteristics. For example, in some cases the same objective may be met through the use of a commercially available film, a teacher developed audio tape and slide presentation, or three different magazine articles.

The materials are utilized by the students in a number of different ways, with emphasis on individual needs. Learners may work independently, in small groups, in large groups, in teams, or any variation of these, depending upon the objectives, the available material, and the students involved. All material, as a result, is as flexible as possible in implementation and as specific as possible in content.



It is student centered, and emphasizes:

A. development of skills,

B. motivation techniques, and

C. reinforcement of learning.

## Validation of Materials: Activity & Results

The curriculum materials have been used in the Elm Street Elementary School and the John Crosson Junior High School during the current year. In every case, pre- and post-tests have been administered, and pupils have been asked for oral and written comments about the program. There was some difficulty in using the materials in the junior high school, because pre-tests showed that students lacked the necessary entry levels for working with the materials. Remedial material had to be utilized before the students could begin to work with regular curriculum materials that had been developed for them. For this reason, one section of non-academic students in the senior high school was used to validate some of the materials designed for the junior high school.

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Validation Results:

It was found that 90 percent of the students achieved the minimum goals of the curriculum, while 25 percent far exceeded the minimum goals.

In general, student reaction to the curriculum was enthusiastic, far more than with the teachers. Teachers have complained that the materials take too much time and detract from other areas they think are far more important than de-

veloping scientific literacy. Several teachers used the materials as little as possible, with relatively little progress on the part of their students. Most of the negative attitudes expressed by students came from classes taught by these teachers. About ten percent of the students disliked the curriculum, claiming that it was "too hard" or that it "interfered with their other work."

There was considerable feedback from parents and community. /34 Some parents complained about the excessive homework their children had, and others objected to the content being taught. The committee for the Abolition of Sex Education in the Schools held a stormy hearing concerning the unit on Population Problems, and attempted, with little success, to get some of the church groups to oppose the program. At another time one class did an analysis of the city seqage treatment plant which resulted in some very unfavorable publicity about current treatment practices. The city council protested, but the teacher was defended by her principal and the school board voted to support her.

In summary, there was considerable evidence that the minimum goals had been achieved with the majority of the students, but work needs to be done in revising the materials and improving some of the weak spots in the program.

# OUTLINE OF MODEL TEACHER INSTITUTE

## C O N T E N T S


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44 . . . . . INSTITUTE STRUCTURE & MANAGEMENT

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part two-b

## Outline of Teachers' Institute

### Purpose

This institute is planned to introduce the new scientific literacy curriculum materials to science teachers who will be using them during the coming year.

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### Participants

John Henderson is science supervisor for the Grand City public schools, a system of about 5,000 students. Henderson's immediate superior is the curriculum director, an assistant superintendent of the district.

There are between 111 and 115 elementary teachers in the system, a junior high school with about 80 teachers, and a senior high school with 60 teachers. Of these, there are seven science teachers in the junior high school, and five science teachers in the senior high school.

The senior high school teachers are well prepared, each with a major in his subject field, except for the physics teacher who has a major in mathematics and a minor in physics (he also teaches two sections of mathematics in addition to his physics assignment). Three of the junior high school

teachers have majors in biology, one in physical education, one in home economics, and two in guidance. However, each has enough science credits on his certificate to qualify him for state certification in junior high school science.

Henderson, in discussing the problem of instituting the new curriculum, has agreed with the curriculum director that all of these teachers should be involved in the inservice program to some degree, but that the greatest emphasis should be given to the junior high school teachers.

## Institute Philosophy

In order that new curriculum materials may be used successfully in the classroom each teacher must become thoroughly acquainted with the objectives and content of the program.

It is not necessary for each teacher to study every topic in detail before beginning to implement the curriculum; but he must be thoroughly familiar with the purposes and philosophy of the curriculum and examine enough of the particular course material in detail so that he will understand the educational framework in which the course was designed. /38

Perhaps the most effective way of helping teachers "catch the spirit" of the program is to use the same teaching techniques in the institute as will be used in the new curriculum.

## Behavioral Objectives for the Institute

Given the curriculum plan for developing scientific literacy, a teacher will

A. learn a definition of scientific literacy and justify its importance in an educational program;

B. evaluate the behavioral objectives listed for the scientific literacy curriculum in terms of

   1. specificity of the behavior called for,
   2. type of learning skill involved,
   3. consistency of the objectives with the stated goals, and
   4. the level of difficulty of the material according to some taxonomy of learning (Gagne, Bloom, or any other);

C. prepare plans for implementing the curriculum in the classroom, making specific suggestions for achieving specific objectives and the general goals of the project;

D. actively seek additional material and make suggestions for further curriculum implementation;

*E. actively participate in discussions with other science teachers and supervisors for improving the curriculum.

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* NOTE: The institute participants will not be told that this is an objective.

## Pre-Institute Activities

All of the science teachers involved in implementing the scientific literacy curriculum are required by their principals to attend the institute. However, in order to assess and meet individual needs, certain pre-institute activities have been developed.

The pre-assessment shown on the following pages must be completed at least three to four weeks prior to the institute. Teachers who indicate little or no experience with the items in question one must go through the entrance exercise described after the pre-assessment. Teachers with average or less than average experience are offered the entrance exercise as an option.

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Institute staff will go over each completed exercise in detail and individually contact the teacher with analysis and recommendations.

PRE-ASSESSMENT FOR INSERVICE INSTITUTE

NAME: _____

ADDRESS: _____

SCHOOL: _____

HOME PHONE: _____

PROFESSIONAL TRAINING:



| DATE(S) | SCHOOL OR COLLEGE | DEGREE |
|---|---|---|

SCIENCE BACKGROUND:

| COURSE NAME | NO. OF HOURS | DATE TAKEN |
|---|---|---|

1. How good do you consider your background? (Circle one)

| | EXCELLENT | | AVERAGE | | LITTLE | NONE |
|---|---|---|---|---|---|---|
| Scientific Literacy | 5 | 4 | 3 | 2 | 1 | 0 |
| Instructional Systems | 5 | 4 | 3 | 2 | 1 | 0 |
| Behavioral Objectives | 5 | 4 | 3 | 2 | 1 | 0 |
| Curriculum Planning | 5 | 4 | 3 | 2 | 1 | 0 |

2. Have you attended conferences or institutes for science teachers on any of the topics mentioned in question one? _____. If so, when? _____

Where? _____

Which one? _____

Check the area listed below in which you have had experience:

_____ Writing behavioral objectives and criterion assessment items.

_____ Designing a more efficient instructional system.

_____ Designing a multi-media learning sequence. If you check this item, describe briefly what you have done.



4. Have you ever analyzed your own instructional system? _____

If so, describe how you did it:

5. What experience (if any) have you had in introducing new courses into your teaching?

6. If you answered #4, evaluate the success of your attempt(s).

Entrance Activity

These activities will be performed by teachers whose response to the pre-assessment indicates a need in these areas, before beginning the institute.

Given an enabling objective, the participant will:

A. Prepare a criterion assessment to measure the mastery of the objective.

B. Prepare a criterion pre-assessment and an entry level assessment for the objective.

C. Outline briefly several learning strategies for achieving the objective.

D. Outline in detail one of these strategies.

E. Outline a plan for validating the material.

F. Outline a plan for implementing the material in the classroom.

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Learning material in this area:

Robert F. Mager. Preparing Instructional Objectives. Palo Altc, California: Fearon Publishers, 1962.

Each teacher taking this activity will be given a copy of this book.

## Institute Structure & Management

Participants may "test out of" specific items in the institute if their pre-assessment indicates they already know the module content.

## Outline of Institute Content

Participants will carry on the following activities:



A. Evaluating instructional systems (text or tape workbook presentation).

B. Why behavioral objectives? (tape/slide or live presentation) also, behavioral objectives in the affective domain (text or live presentation).

C. Scientific literacy.

   1) Definition (live presentation with analysis groups).

   2) Writing behavioral objectives (text or live presentation.

   3) Writing criterion assessment items (text or simulation game).

D. Analysis of Curriculum for Developing Scientific Literacy (analysis groups).

E. Examples of learning situations used in scientific literacy curriculum (videotape demonstration or live lab).

F. Examples of learning unit (live lab).

G. Practice in teaching a learning unit (videotape for microteaching).

H. Plans for continuing revision (analysis groups).

I. Evaluation

1) of the curriculum plans (analysis groups),

2) of the institute (worksheet and analysis groups).

Learning Strategies

The institute will be activity centered; from the beginning each participant will have an active role. Individuals will be shown good teaching techniques by having them utilized in the institute. Emphasis will be on learning and provision of a learning atmosphere, with the institute director taking an advisory role rather than being the sole learning source available to the participants. /4

The institute will exemplify the way the curriculum should be presented to the students. The institute director's role, therefore, is that of organizer and director of the learning environment, in contrast to the usual role as lecturer and the source of information.

The pre-test for the institute provides the basis for preparing a tentative activity schedule for each participant to follow. However, it will be possible for the participant to change his program at any point desired, as determined by a director/participant conference.

The institute will employ various media

A. to demonstrate selection of appropriate media for specific content,

B. to offer learning strategies which accommodate individual learning styles, and

C. to prevent boredom from traditional lecture presentation.



Plans for Revision

The participant will learn that the curriculum program will be under constant revision, with plans for considerable change during the first couple of years and major revision after about five years. Participants' institute activities and validation information from the first year of operation will form the basis for revision.

Experimental Use

Each teacher will be asked to select a curriculum unit or topic for experimentation and utilize the unit in a class. Teachers will then discuss the success of the experiment, and offer suggestions for improving the learning material. Schedules will be arranged so that each teacher can obtain the assistance of the science supervisor, or a master teacher in presenting the unit if there is difficulty.

Released Time

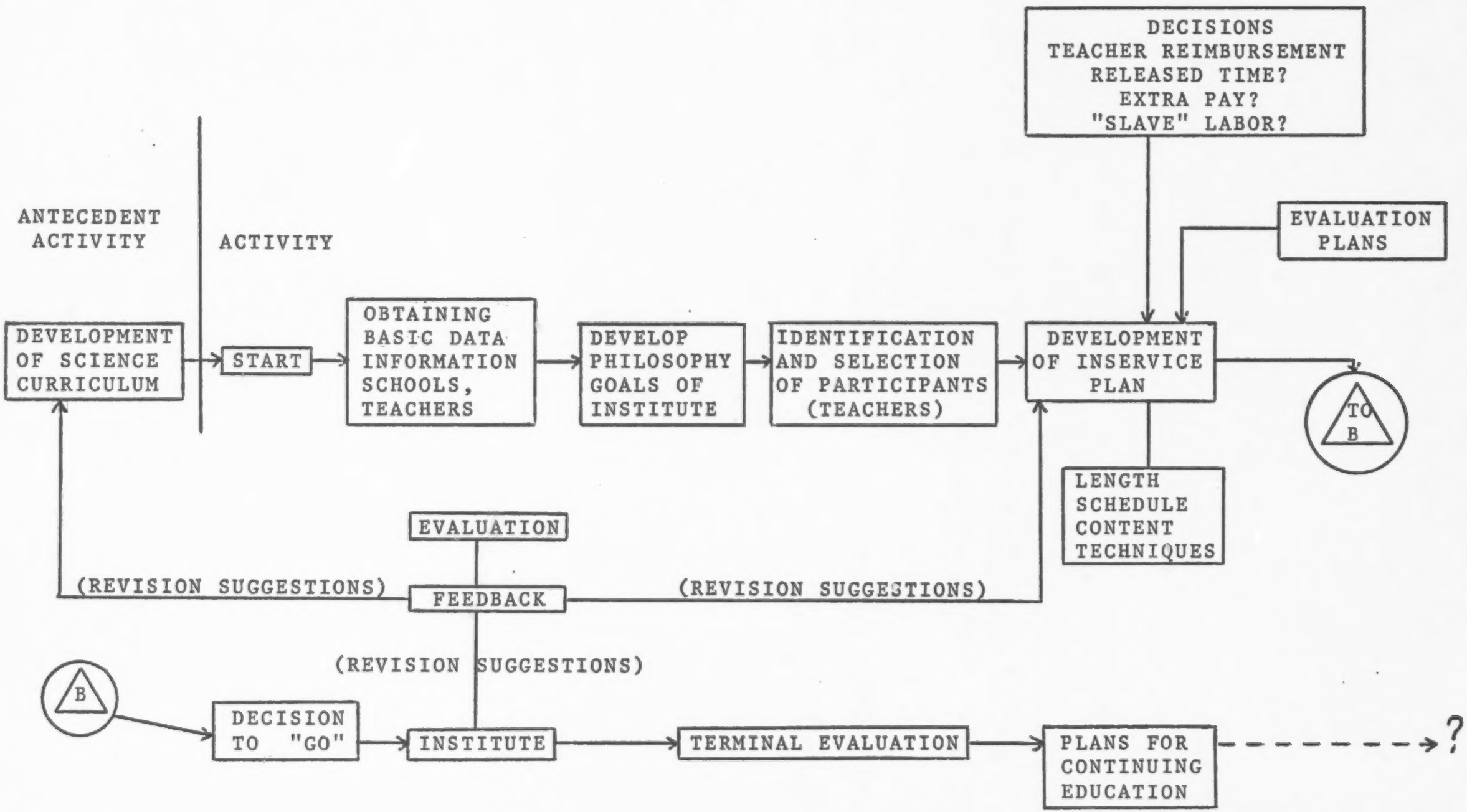
All teachers will participate in the institute during the last two weeks in August, for which they will be paid an extra two weeks salary at their standard rate for the school term.

Schedules have been arranged so that all science teachers have every fourth Friday afternoon free during the school year for inservice work and discussions. About half of these will be formal sessions, with all teachers expected to attend, and the rest are informal, voluntary sessions, where teachers may request conferences or obtain help with specific problems.

## Evaluation of the Institute

At the conclusion of the institute, and twice during the first year of the curriculum trial, teachers will be asked to provide an informal statement of the effectiveness of the inservice program as well as the curriculum including suggestions for improving it. Any suggestions that appear to be helpful will be used in changing future institute plans and in revising the curriculum materials. Discussion will be open and frank, with criticisms given in a professional manner. At the conclusion of the project a final report will be filed with the assistant superintendent which will include some teacher criticisms and information on how these suggestions were utilized to improve the program.

FLOW CHART OF A PLAN FOR AN INSERVICE EDUCATION PROGRAM FOR INTRODUCING A NEW CURRICULUM



## Directions

Now that you have gone through the curriculum structure and model inservice institute, analyze the institute in terms of practicality, and possible success in meeting the institute objectives, basing your analysis on the curriculum, students, and teachers described. It is your job, either alone or with a small group of other science supervisors, to improve and revise this institute to make it workable. If a behavioral objective is bad, revise it; if the flow chart lacks basic areas, add them. A verbal analysis is not enough; specific revisions are necessary.

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Material listed in the appendix is available to help in making specific revisions. Refer to it as necessary.

When you have finished take a break. After coffee, tea, or milk, go on to part three.

part three

## CONCLUDING ACTIVITIES

For this final section you have three jobs.

First, review the inservice program plans you prepared in Part One - Initial Activity. Make whatever changes you think are desirable. Tell why you think each change was necessary.

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Second, on a separate sheet of paper, answer the following questions about Part Two:

1) How well does the philosophy and content of the curriculum outline for developing scientific literacy fit into your philosophy of education?

2) What changes would you recommend for the curriculum plan if you were asked to adopt it?

3) What changes would you make in the inservice plan if you were asked to implement the curriculum described?

Third, briefly describe how effective you feel this set of materials has been in improving your knowledge and skills for utilizing educational technology.

List any areas of educational technology you wish more information about or feel should be brought out more strongly in the material.

You may do this alone or with other science supervisors. However, it must be emphasized that the final product is to be a revised inservice institute that <u>you</u> can use. If it has been merely an academic exercise your work on these materials will simply have been "busy work."

appendix

# B I B L I O G R A P H Y


Behavioral Objectives in the Affective Domain.

A model for constructing educational objectives and evaluating their outcomes, 42 pages; distributed by the National Science Teachers Association, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.





Diagnostic Testing.

Audio tape produced by the National Science Teachers Association Project on Educational Technology, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

Norm Reference versus Criterion Reference Testing.

Audio tape produced by the National Science Teachers Association Project on Educational Technology, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

Principles and Practice of Instructional Technology.

A programmed, inservice workshop. Sold as a package, it consists of approximately 20 hours' instruction: 15 audio tapes, 12 filmstrips, 10 workbooks, a monitor's manual and a script book. According to the brochure, a teacher completing the workshop will have skill and practice in (1) writing behavioral objectives, (2) writing test items to test the objectives, (3) designing instruction which will keep his students interacting with the subject matter, and (4) testing the instruction to see if it does what it was intended to do. Distributed by General Programmed Teaching, 424 University Avenue (P.O. Box 402), Palo Alto, California 94302.

James Popham and Eva L. Baker slide/tape series.

Seven validated audiovisual programs, accompanied by response sheets, pre-tests and post-tests. Individual program titles are:

Selecting Appropriate Educational Objectives
Promoting Perceived Purpose
Educational Objectives
Establishing Performance Standards
Evaluation
Systematic Instructional Decision-Making

Available as a set or individually from Vimcet Associates, P.O. Box 24714, Los Angeles, California 90024.



"Quik-Topic" Filmstrips".

A series of filmstrips with accompanying audio tapes, produced and distributed by Educational Media Incorporated, 106 West Fourth, Ellensburg, Washington, 98926. Selected titles include:

Large Group Teaching Auditoriums
Television Utilization in Education
Dial Access Information Retrieval Systems
Computer-Assisted Instruction.

Really Understanding Concepts: or in frumious pursuit of the jabberwock.

Slide/tape presentation with workbook, produced and distributed by Susan M. Markle and Philip W. Tiemann, University of Illinois at Chicago Circle.

Selection and Use of Programmed Materials.

Color filmstrip with accompanying handbook, produced and distributed by the Department of Audiovisual Instruction, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

Why Behavioral Objectives?

Overhead transparency/audio tape presentation; includes script and suggestions for use, copy of audience participation sheet, and criterion test; produced and distributed by the National Science Teachers Association, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.